A Unifying Strategy for Data Integration for Global Force Management

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What Is GFM?

- Under the *US DOD Net Centric Data Strategy* (9 May 2003), **Communities of Interest (COI)** are to be established to address organization and maintenance of data.

- In the summer of 2003, a COI for **Global Force Management (GFM)** was established by the Joint Staff Force Structure Directorate (J-8) and co-chaired by the US DOD Deputy Under-Secretary of Defense (Personnel & Readiness)/Readiness to tackle the challenges imposed by the *Net-Centric Data Strategy*.

- The major impetus for the establishment of the GFM-COI is the development of reliable and maintainable data sources in a net-centric environment to support decisions relating to force management for systems such as the new **Defense Readiness Reporting System (DRRS)**.

- A project called the **GFM Enterprise Data Initiative (EDI)** is underway to investigate and evaluate GFM data structure, creation, management, and accessibility (e.g., via web service enabling). This is a *data production* program.

GFM-EDI Focus Areas

Today's Topics

- **Establishment of a Policy and a Joint management entity**

- **Authoritative Data Sources (ADS) from all DoD components**

- **Force Structure Construct (FSC) for all DoD components**

- **Information Exchange Standards & Specifications (IESS) (Data Model)**

- **Web-service-enabling standards for Net-Centric Data Strategy**

- **Extensible Markup Language (XML), in coordination with DRRS RML (Readiness Markup Language)**

- **Enterprise Identifiers (EIDs)**
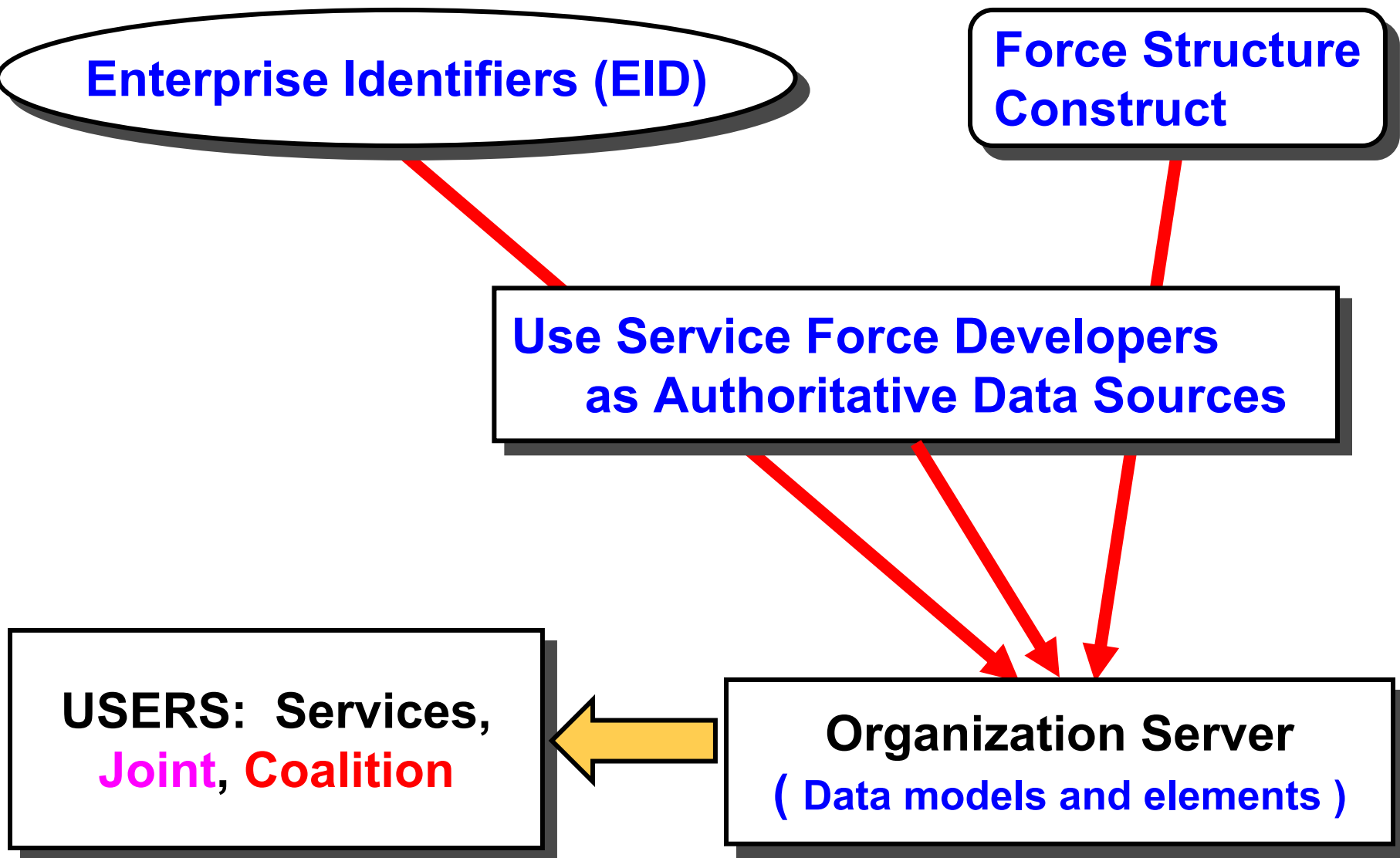
The GFM Data Strategy

Enterprise Identifiers (EID)

Force Structure Construct

Use Service Force Developers as Authoritative Data Sources

USERS: Services, Joint, Coalition

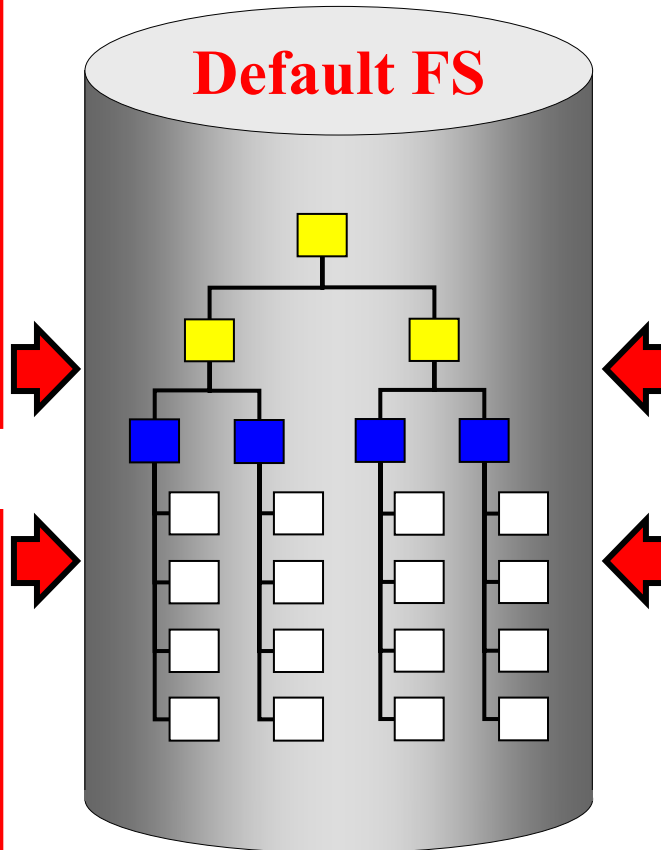**Organization Server**
(Data models and elements)

Basic Concept:
"Force structure pulls everything together"
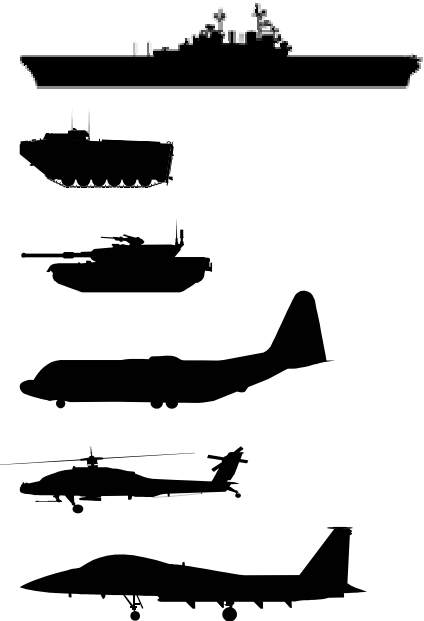

People

Because numerous data items ultimately link to the force structure skeleton – use it as the basis to integrate data.
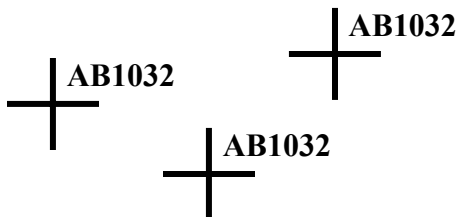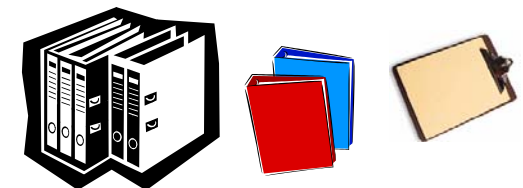
Default FS

Materiel

Targeting

AB1032
AB1032
AB1032

Plans/Orders/Obj

Unifying Force Structure Authoritative Data Sources

Problem: Negotiating the
Unit Identification Code (UIC) Boundary

AEF / Corps / Fleets / MEF

GFM Process

Operations

Manpower

Upper Tier Authoritative Sources

ASORTS GSORTS JOPES
MilPDS   TRMS

Upper Tier Force Structure

Bottom UIC Level (Echelon)
Historical but Arbitrary Boundary

Lower Tier Force Structure

Lower Tier Authoritative Sources

USA MTOE   USN SHMD   USAF UMD
USMC TO/TE   SMD/SQMD   JS EJMAPS

Billets / Equipment

Four Quadrants of Force Structure Data Sources

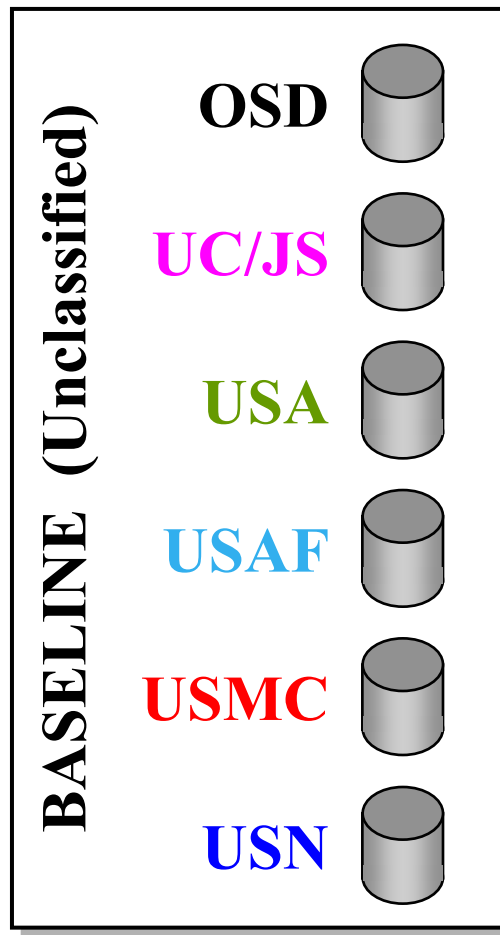|	**Authorization Data** **"What Should Be"**	**Status Data** **"What Is"**
Upper Tier (Operations)	**Operational Planning Systems (ADCON View)** **Internal Service Operations & Planning Data** I	**Operational Execution Systems (OPCON View)** **SORTS / JOPES / etc. Battle Command Systems!** III
Lower Tier (Pers / Equip)	**Personnel & Logistics Planning Systems** **Service Manpower & Logistic Data** II	**Personnel & Logistics Execution Systems** **Personnel / Logistic Reporting Data** IV

Will the Real Authoritative Data Source Please Stand Up?
They All Do!

Exploiting Default Force Structure
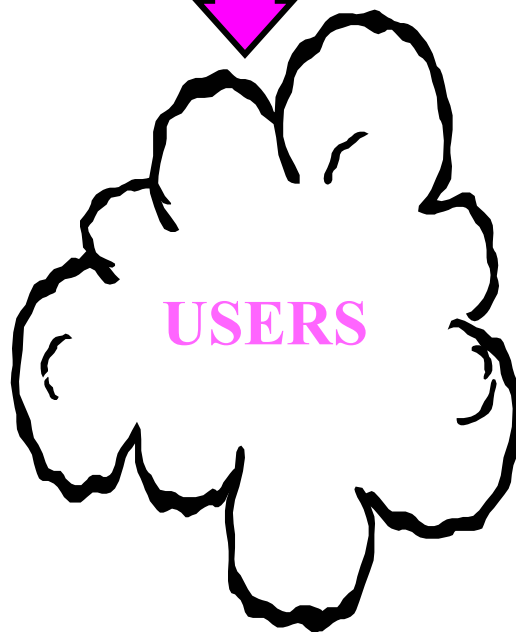# to pull the pieces together

Org Servers
"What Should Be"

Personnel Roster
(e.g, DIMHRS)

Status Data
"What Is"

BASELINE (Unclassified)

OSD

UC/JS

USA

USAF

USMC

USN

USERS

READINESS (Classified)

Force 1

Force 2

Force 3

Force 4

Force N

Created & Maintained by
the Force Development
Community
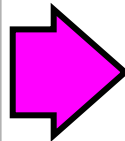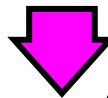
Property Book
(Serial Numbers)
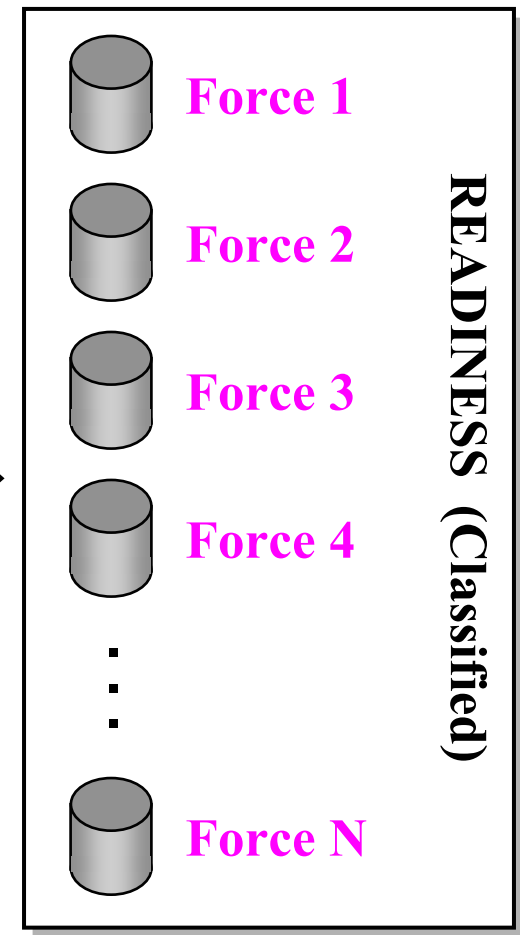
Maintained and
Augmented by Units

Concepts and Principles Behind Formal Hierarchical Structures

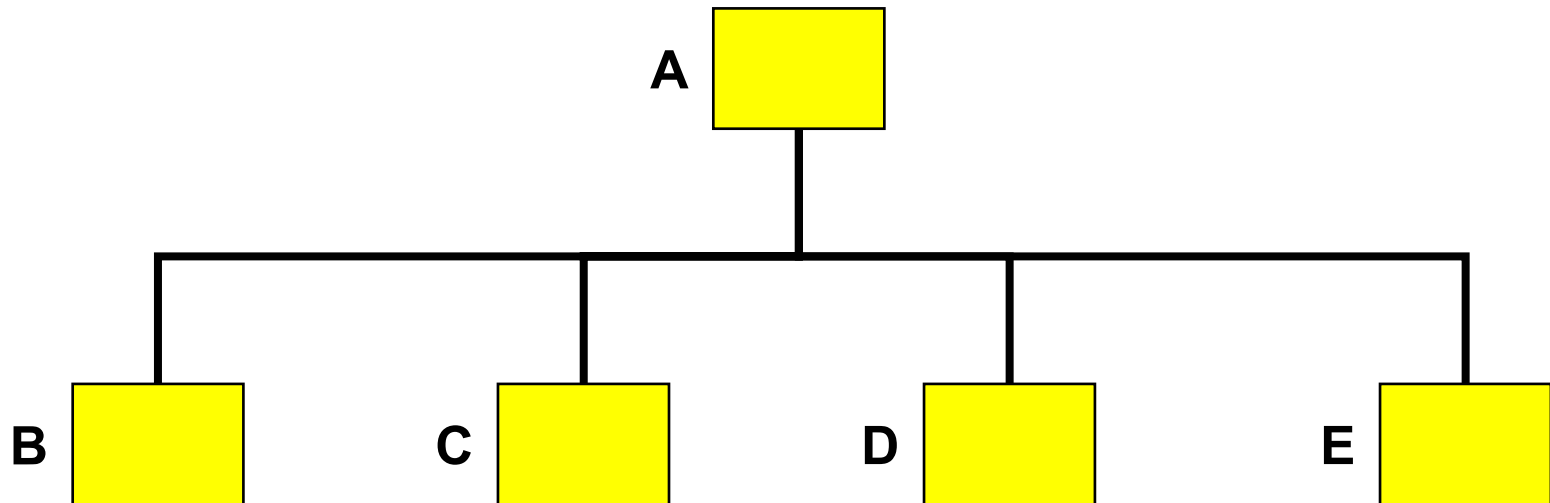# "The GFM Force Structure Construct"

Basic Tenets of
Theory of Default Operational Organizations

- **There is never one correct way to represent (or model) something as complex as battle command. But we must agree on a few fundamental concepts.**

- **Tenet #1:** At the heart of the representation of battle command is the concept of *force structure*.

- **Tenet #2:** A default force structure exists that is composed of a set of default **organizations** that are linked together with a default **command structure**.
This force structure is relatively stable (we categorize it as *stationary data*) and, if designed properly (i.e., is *richly populated*), it can be used as the base structure for integrating battle command entities and building arbitrary *orders of battle*.
The sets of default nodes are called the
Default Operational Organizations (DOO).

- **Tenet #3:** Operational command structures (i.e., Unit Task Organizations) are fluid, and are nearly always constructed by modifying (i.e., re-linking the nodes of) the default force structure.

Goal: <u>Stable</u> Nodes - <u>Dynamic</u> Links.

5 Nodes: { A, B, C, D. E }

4 Links: { (A,B), (A,C), (A,D), (A,E) }

Reconfiguring a Default Force Structure

Temporary Alias:
"Team Alpha"

Team Alpha

Temporary Parent

$t_1 : t_2$

CO HQ

1

2

3/B
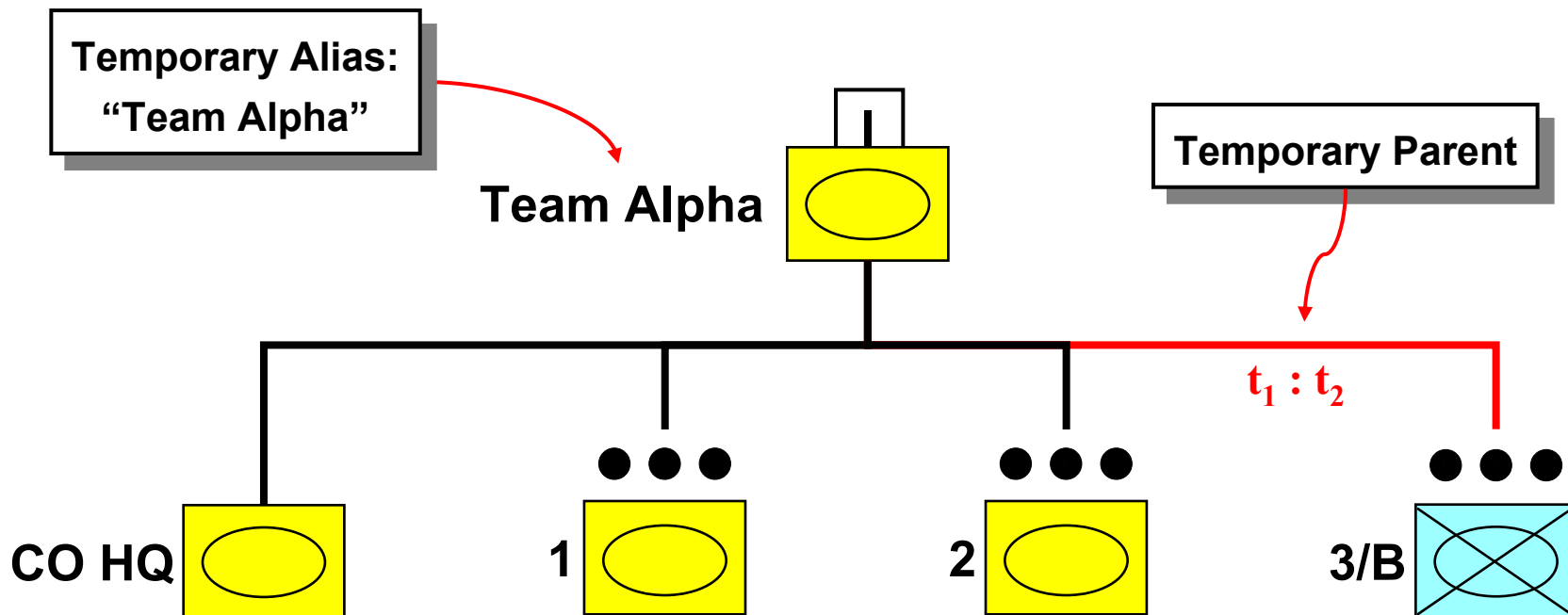
No new nodes were required – only existing organizations were re-linked.

A new graph (Unit) was created with existing organizations.

If the Default Force Structure is Carefully and Richly Populated, Then

Task Organizing Does Not Require Creating any "New" Organizations

Stable Nodes - Dynamic Links.

Adding Time
for Multi-Year Force Structure Diagrams

Timed-Based Tree Graphs to Support Multi-Year Force Structure

Base
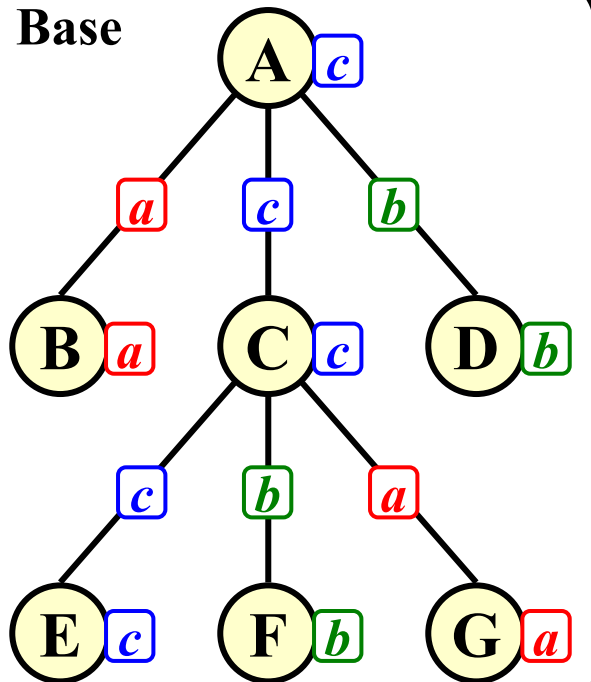
Add Labels to Nodes & Links

T_x
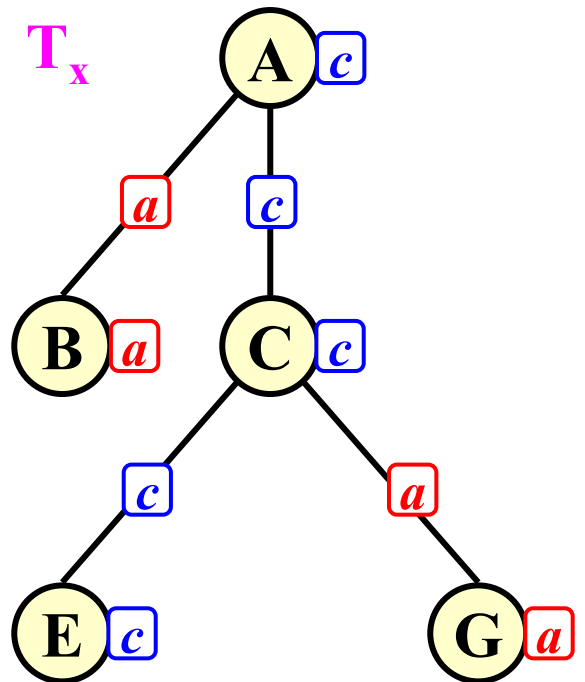
Tree Filtered on [a] or [c]

T_y
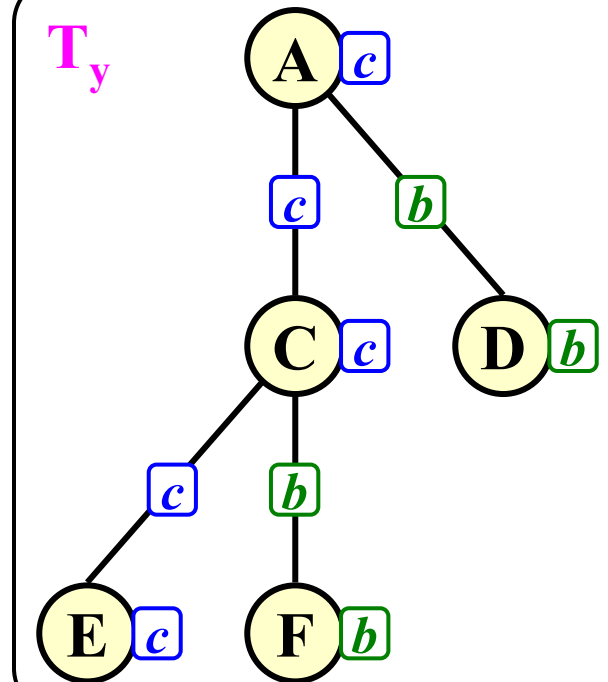
Tree Filtered on [b] or [c]
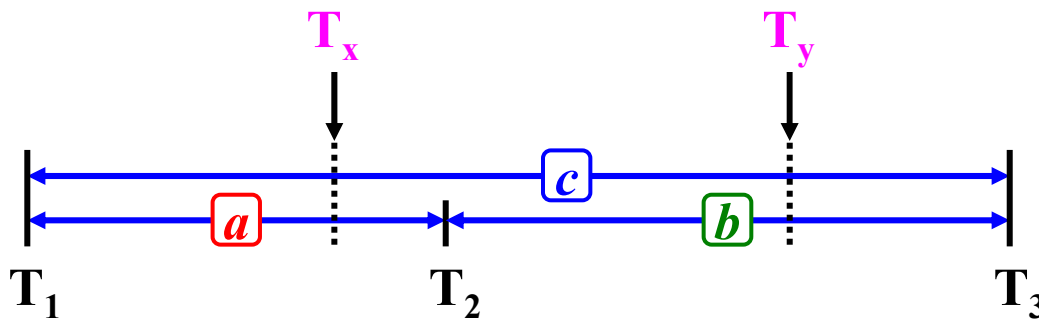
Use Time Intervals as Labels

$$T_1 \leq T_x < T_2 \leq T_y < T_3$$

Examples: Org Tree with Times

Org Tree:

3ʳᵈ - 9ᵗʰ Cav Bn

s_date: 1 Jan 1990
t_date: 31 Dec 2010

s_date: 1 Jan 1990
t_date: 16 Aug 2001

HHC   A   B   C   D
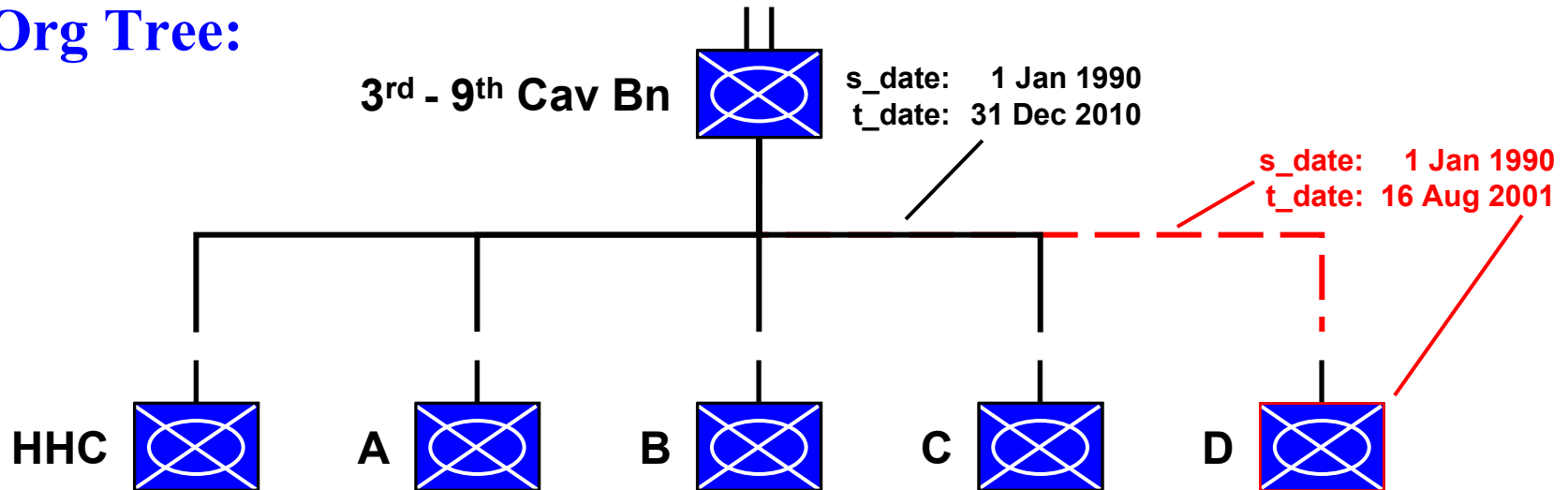
Transition from L-Series to F-Series Structure on 17 Aug 2001

Time is REAL time – it represents an Effective Date (EDATE)

Why Put A Node (Aggregation Point) in a Tree ?
Three Categories of Organizations (Nodes)

- **Billet**: <u>Leaf node</u> with a 1:1 correspondence with a person

- **Crew**: Internal node with a 1:1 correspondence with a piece of materiel that requires operation by one or more persons and transports those persons.

- **Doctrinal**: Internal node that serves as an arbitrary aggregation point due to doctrine, tactics, techniques, or procedures

is_composed_of

Regiment B B

C **Squadron C**

D **Company D** E   F   G

H   I   J   K   L   M   N   O

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
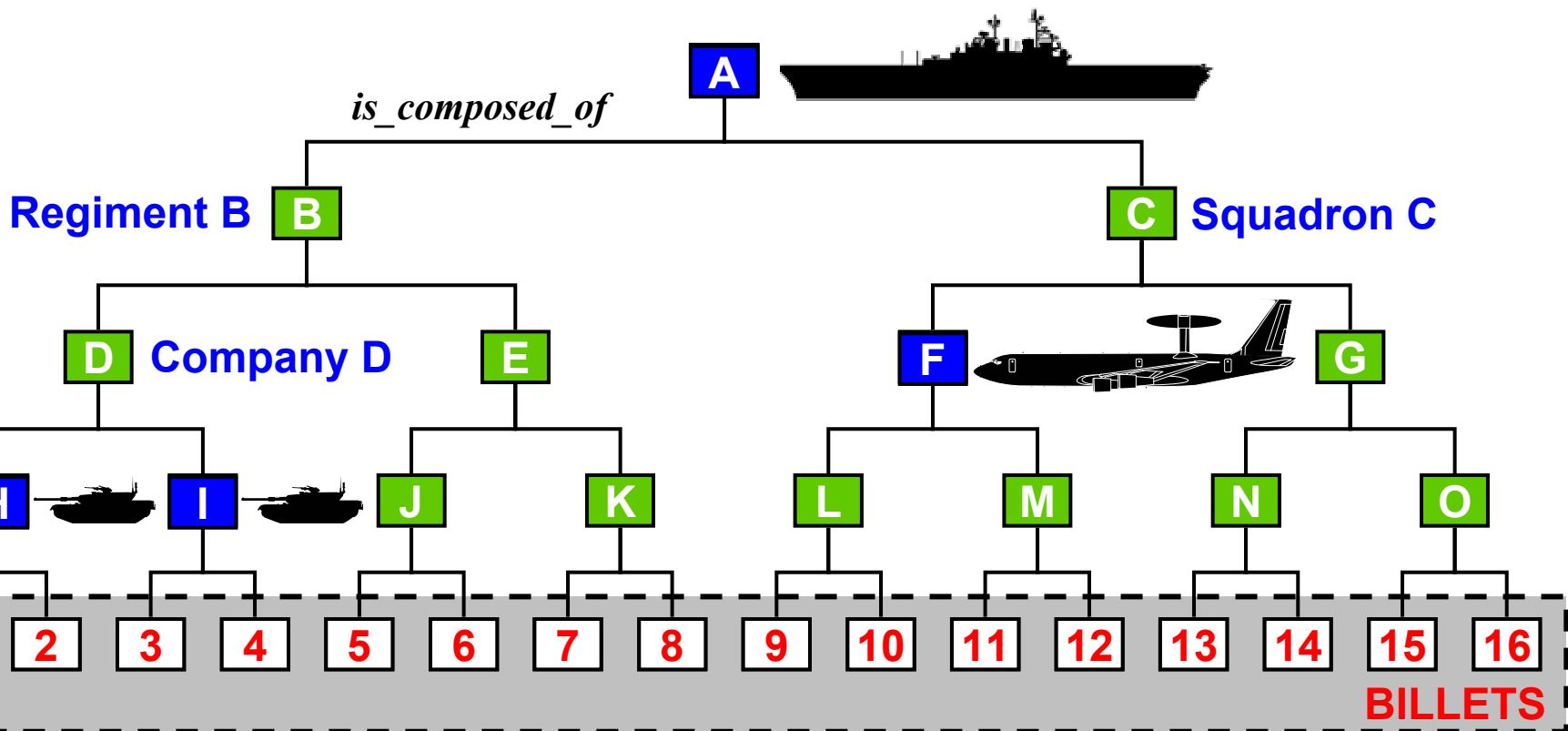
BILLETS

Adding Crews and Billets Enables Integration of Other Entities via the Org Tree

Relationships Between:

(1) Org To Org

(2) Person To Org (i.e., billets)

(3) Materiel To Org (i.e. crews)

A Tank Sect

HQ **M1**   WM **M1**

PL   TC

GNR   GNR

LDR   LDR

DVR   DVR

Organization

Materiel

SSG Jones

SGT Smith

PFC Miller

SPC Lucas

Person
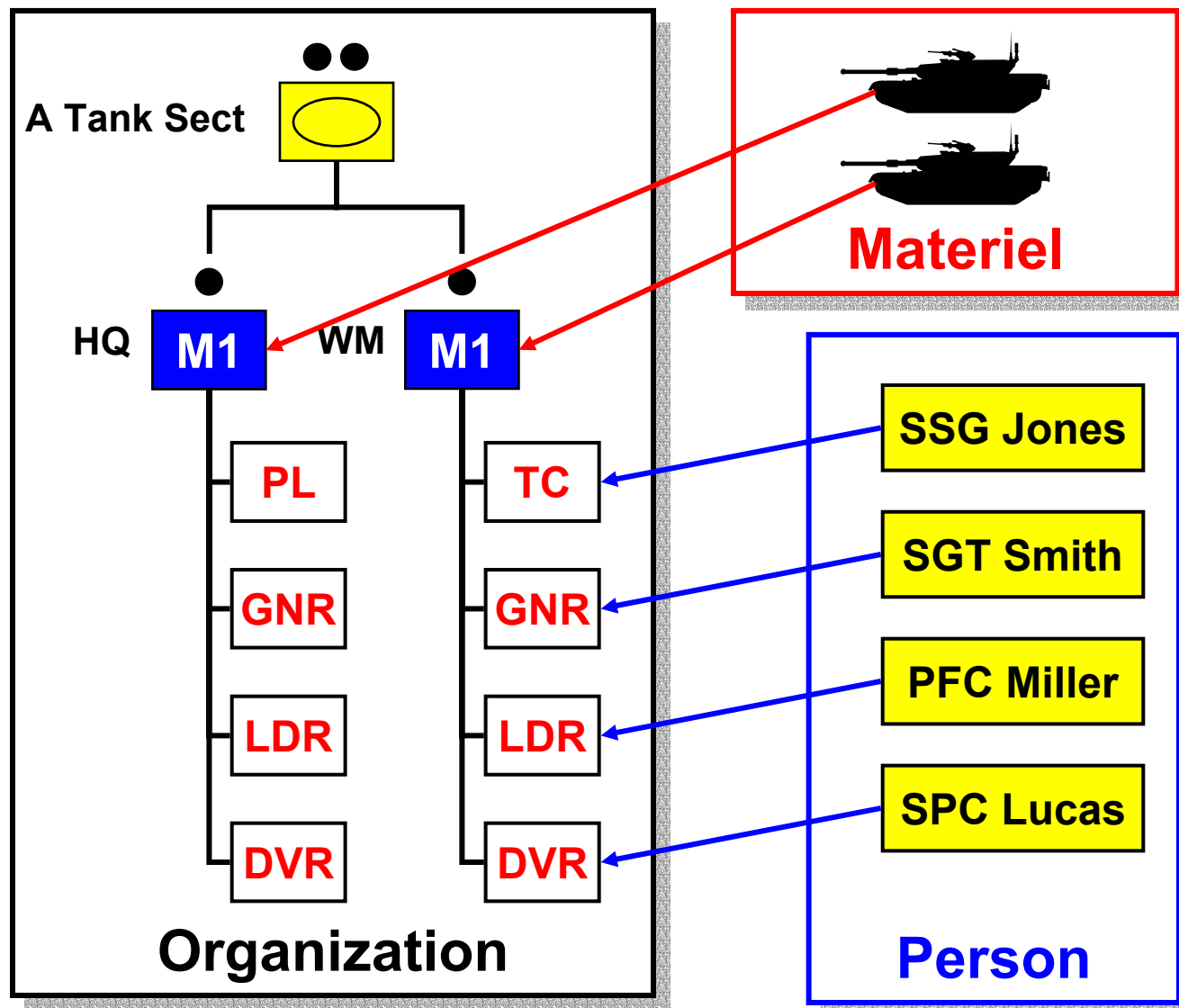
Example of a Default Operational Force Structure

Node Legend

- Doctrinal Organizations (yellow)
- Crew Organizations (blue)
- Billet Organizations (white)

94	Organizations	
14	Doctrinal Organizations	15%
17	Crew Organizations	18%
63	Billets	67%
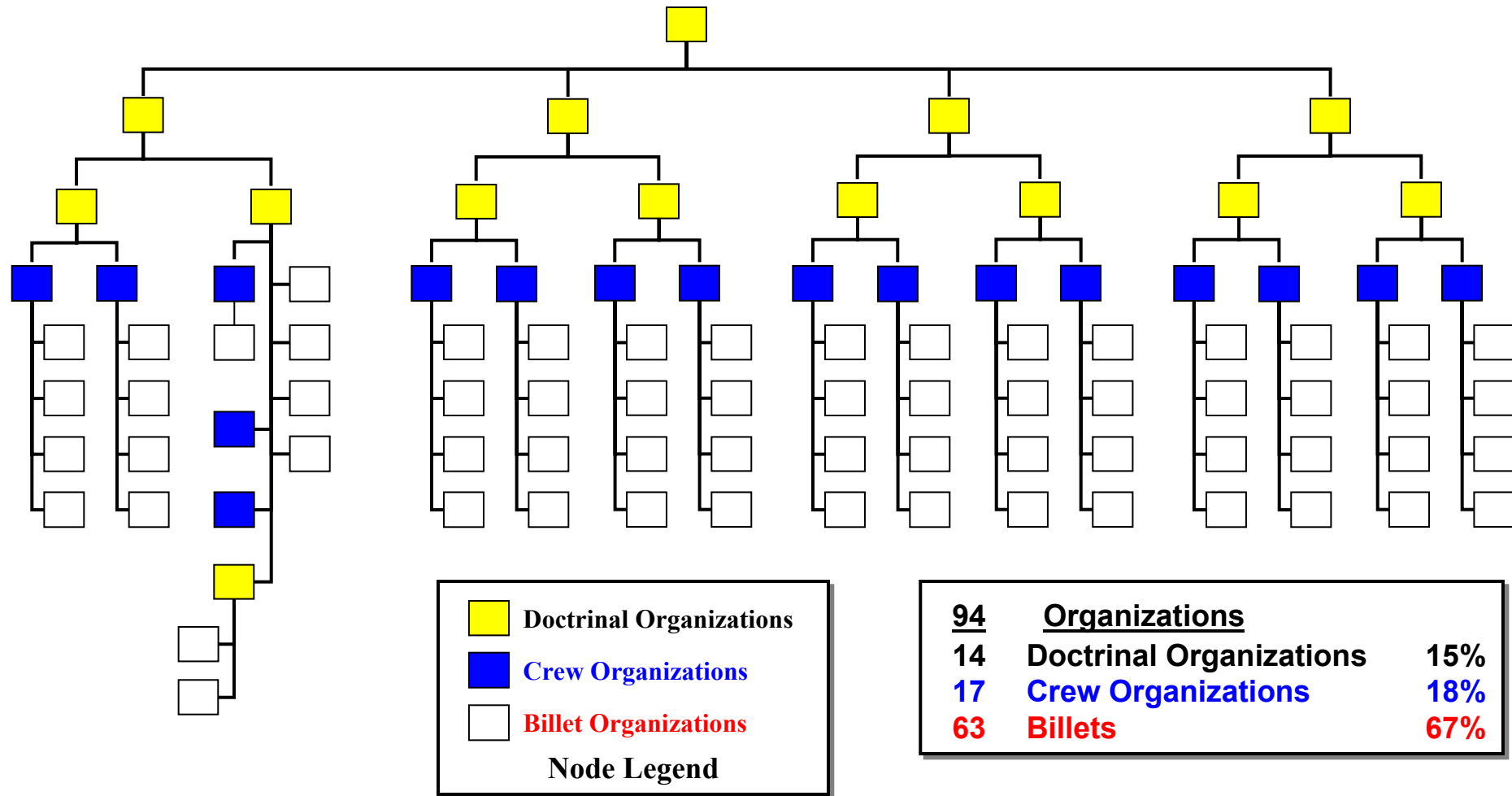
Example: A Plausible Default Force Structure for "Tank Company A"

A ⬭ 1-99 AR BN ⟵ Lowest UIC

Node Legend
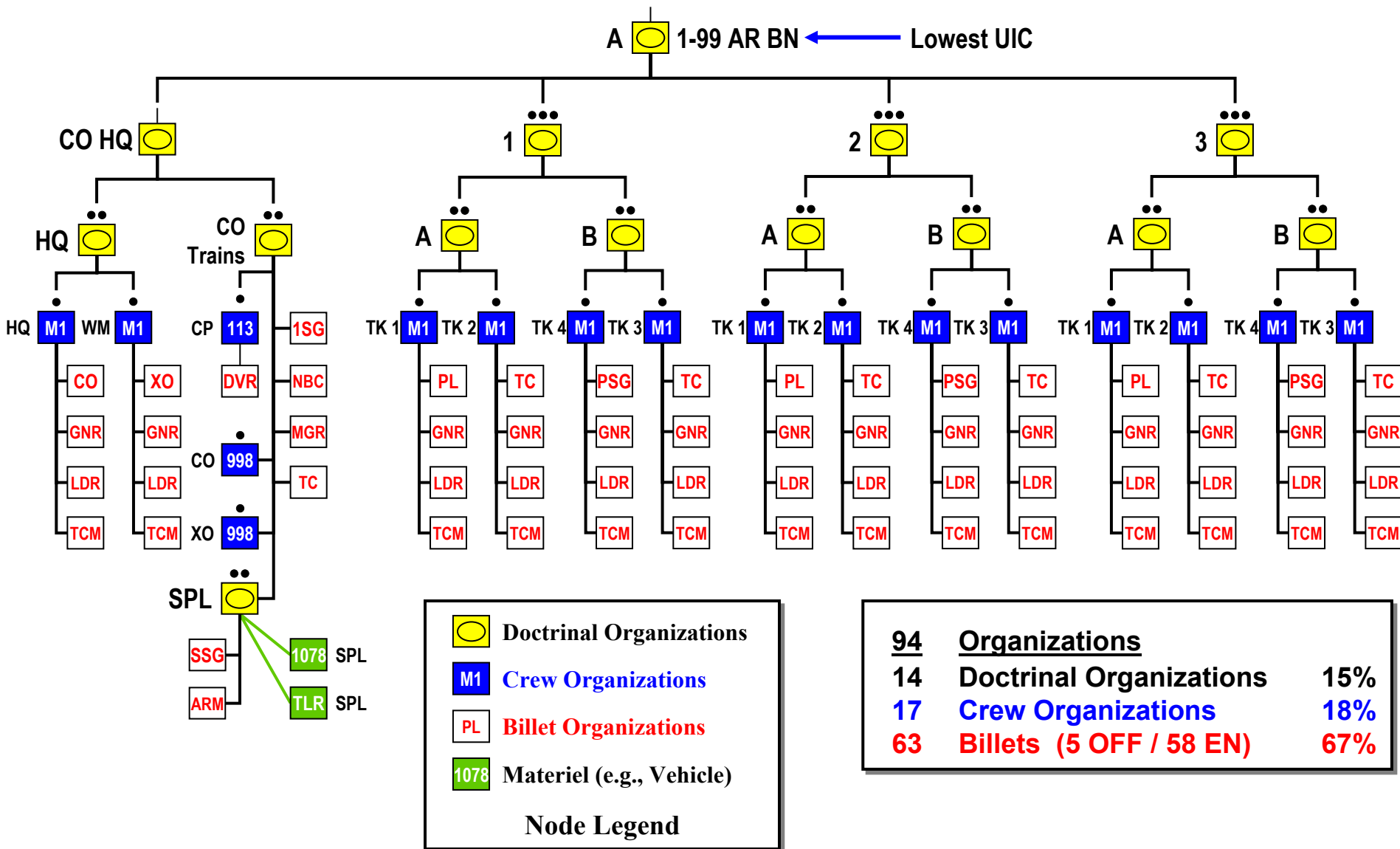
Symbol	Description
⬭ (yellow)	Doctrinal Organizations
M1 (blue)	Crew Organizations
PL (white)	Billet Organizations
1078 (green)	Materiel (e.g., Vehicle)

94	**Organizations**	
14	**Doctrinal Organizations**	**15%**
17	**Crew Organizations**	**18%**
63	**Billets (5 OFF / 58 EN)**	**67%**

Doctrinal Links (aka *Roles*) Versus Doctrinal Organizations

Perceived

MEU
- CE
- GCE
- ACE
- CSSE

Actual

MEU
- CE — HQ
- GCE — 1/8
- ACE
- CSSE
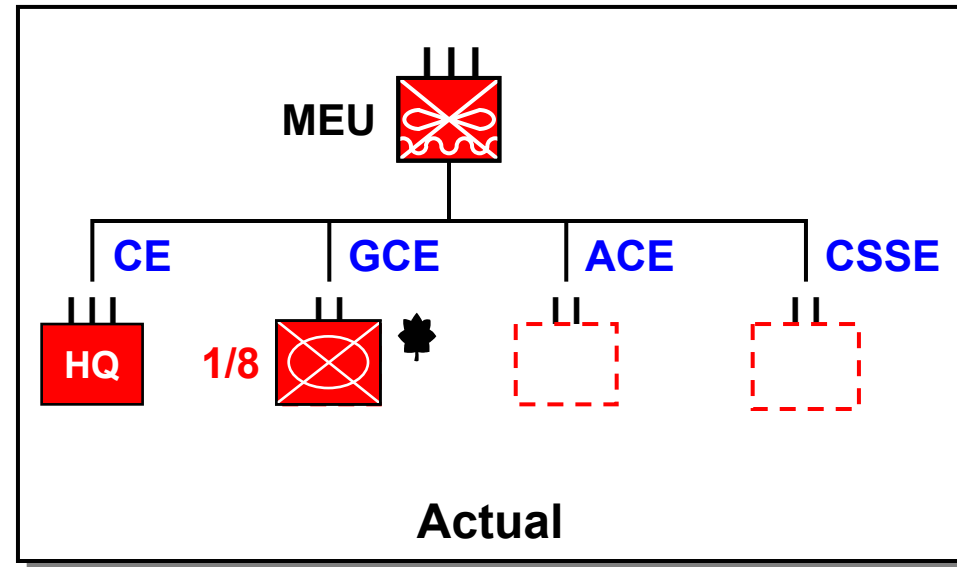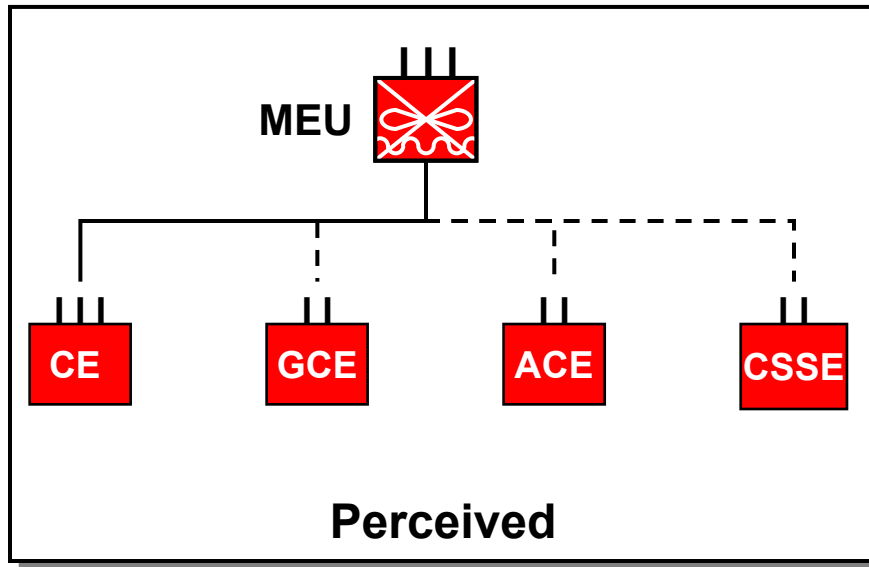
These are NOT organizations, but <u>predefined</u> links to organizations, or *roles*.

For example, BLT 1/8 serves the role of GCE.

Roles are common in aviation – to aggregate non-habitual entities:
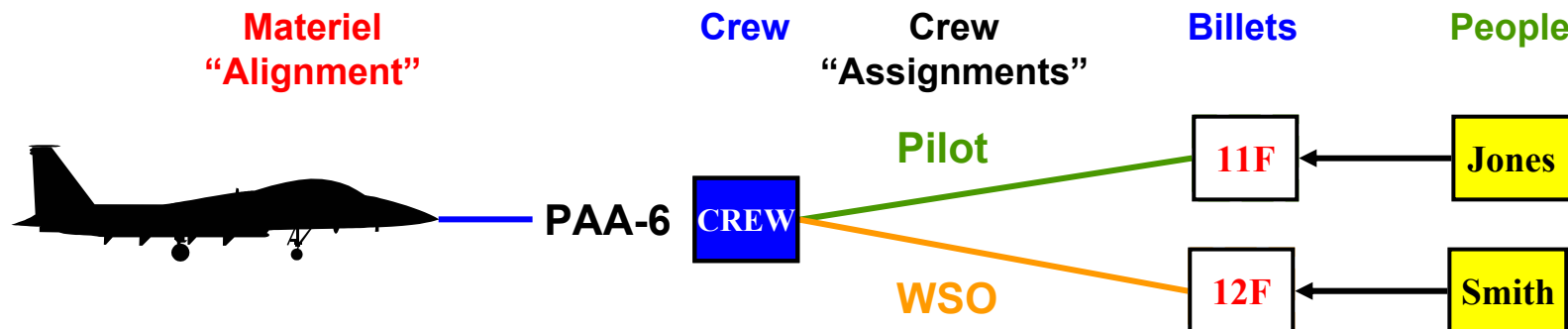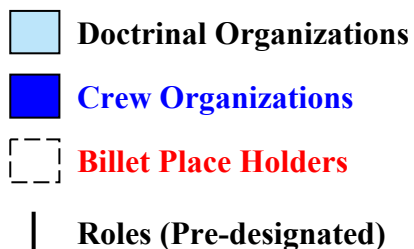
Materiel "Alignment"	Crew	Crew "Assignments"	Billets	People

PAA-6 — CREW

- Pilot → 11F ← Jones
- WSO → 12F ← Smith

Example: Default Operational Force Structure With Many Roles (Predefined Links)

Tree Legend

- ☐ Doctrinal Organizations
- ■ Crew Organizations
- ⌐ Billet Place Holders
- L Roles (Pre-designated)

37	Organizations	
8	Doctrinal Organizations	21%
1	Crew Organization	3%
28	Roles (Billet Place Holders)	76%

Aviation Example: A Possible Default Operational Force Structure for "AWACS Crew 6"
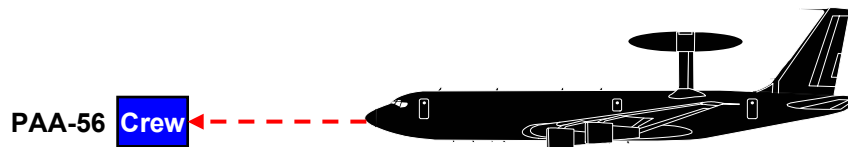
Materiel w/ Tail Number: 29000

PAA-56 **Crew**

Flight Crew
- Aircraft Cdr / Pilot
- Co-Pilot
- Navigator
- Flight Engineer

Mission Crew Commander

Mission Crew

Surveillance Team
- Air Surveillance Officer
- Senior Surveillance Technician
- Airborne Surveillance Technician 1
- Airborne Surveillance Technician 2
- Airborne Surveillance Technician 3
- Airborne Surveillance Technician 4
- Airborne Surveillance Technician 5

Weapons Team
- Senior Weapons Director
- Air Weapons Officer / Weapons Director 1
- Air Weapons Officer / Weapons Director 2
- Air Weapons Officer / Weapons Director 3
- Air Weapons Officer / Weapons Director 4
- Air Weapons Officer / Weapons Director 5
- Air Weapons Officer / Weapons Director 6

Electronic Support Cell
- Electronic Combat Officer
- Broadcast Intel Operator

Communications Technical Team
- Communications Operator
- Communications Technician 1
- Communications Technician 2

Radar Technical Team
- Airborne Radar Technician 1
- Airborne Radar Technician 2

Computer Display Technical Team
- Computer Display Maintenance Technician 1
- Computer Display Maintenance Technician 2

Tree Legend
- Doctrinal Organizations
- Crew Organizations
- Billet Place Holders
- Roles (Pre-designated)

37	Organizations	
8	Doctrinal Organizations	21%
1	Crew Organization	3%
28	Roles (Billet Place Holders)	76%

The Disparate Admin and Operational Command Structures Do Not Cause A Problem

Administrative Command Structure (Squadrons / Flights) Vs. Operational Command Structures (Mission Packages) are Different but Compatible:

From UMD (1999):

CC — LTC, LTC, CIV

CCQ — LT, MSGT, TSGT, SSGT, SRA, CIV

DO — LTC, LTC, MAJ, MAJ, CAPT, MSGT, 3 SSGT, 5 SRA, 4 A1C, CIV

SGPFS — 2 CAPT, 2 SSGT, SRA

DOF
A   B   C   D   E

5 LTCOL (Flight Cdrs), 2 MAJ, 11 MAJ, 9 CAPT, 6 CAPT, 12 CAPT,
16 LT, 7 LT, 42 LT, 2 SMSGT, 17 MSGT, 25 TSGT, 45 SSGT, 53 SRA, 57 A1C

DOL — MSSG, 3 SSGT, 4 SRA, 3 A1C

CREW PAA-1
CREW PAA-2
CREW PAA-3
CREW PAA-4
CREW PAA-5
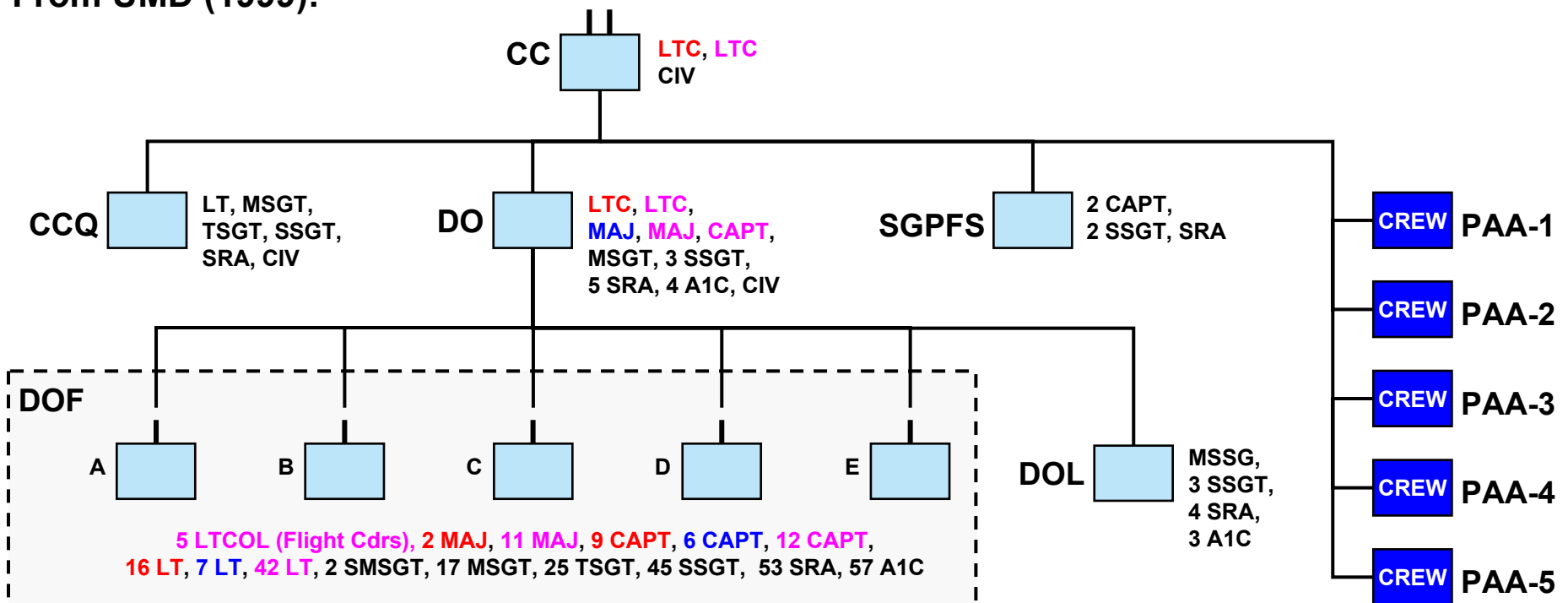
Pilot (11R)
Navigator (12R)
Air Battle Manager (13B)

Add Crews Somewhere

Operational Links Enhance,
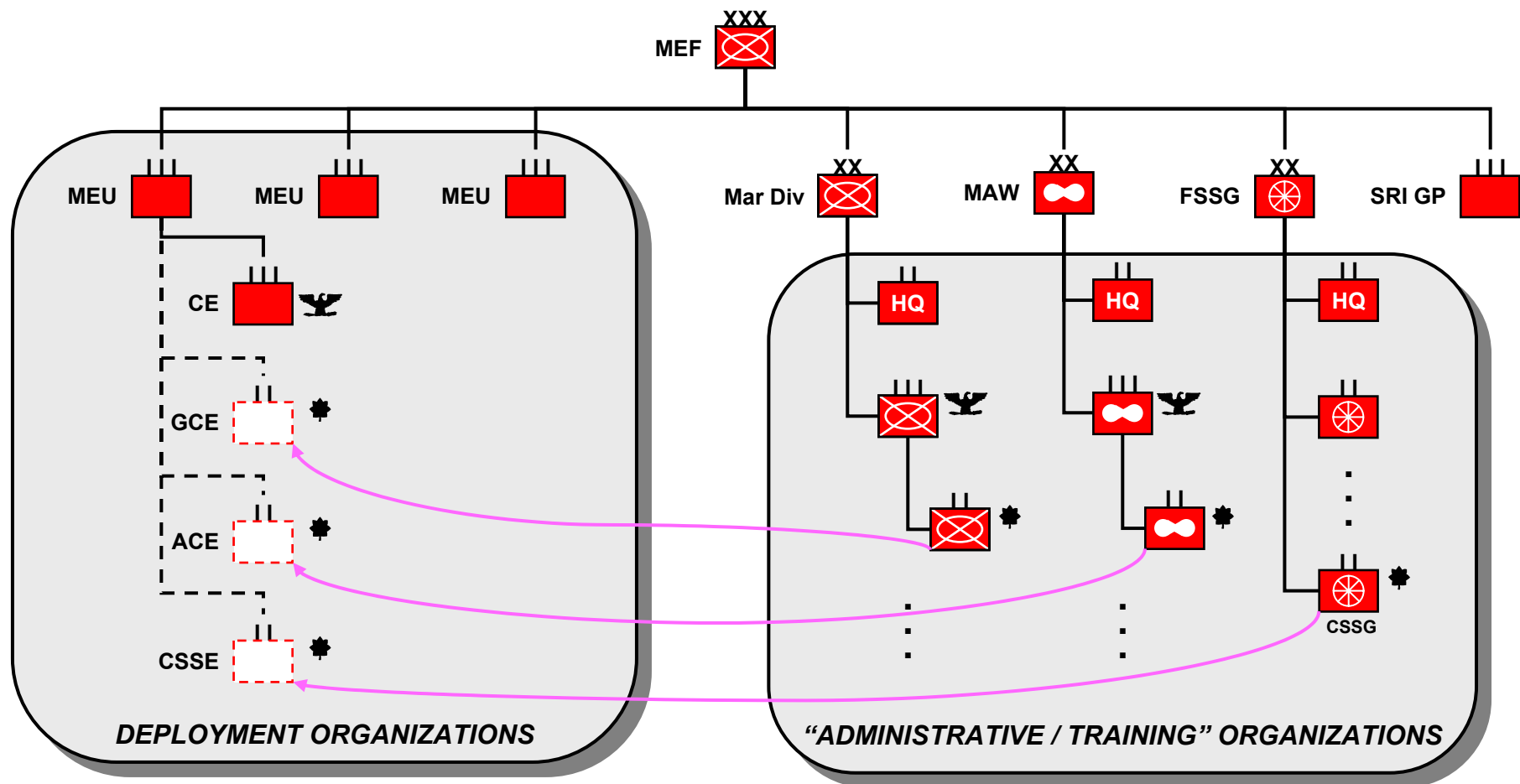# Not Replace, Administrative Links

Operational command structures do not replace administrative ones - they add information, not delete it

Types of Links are Limited Only By One's Imagination:
Is-Led-By Links Denote Who Is In Charge

"*Is-Composed-Of*"

Billets - Leaf Nodes

"*Is-Led-By*"
Association
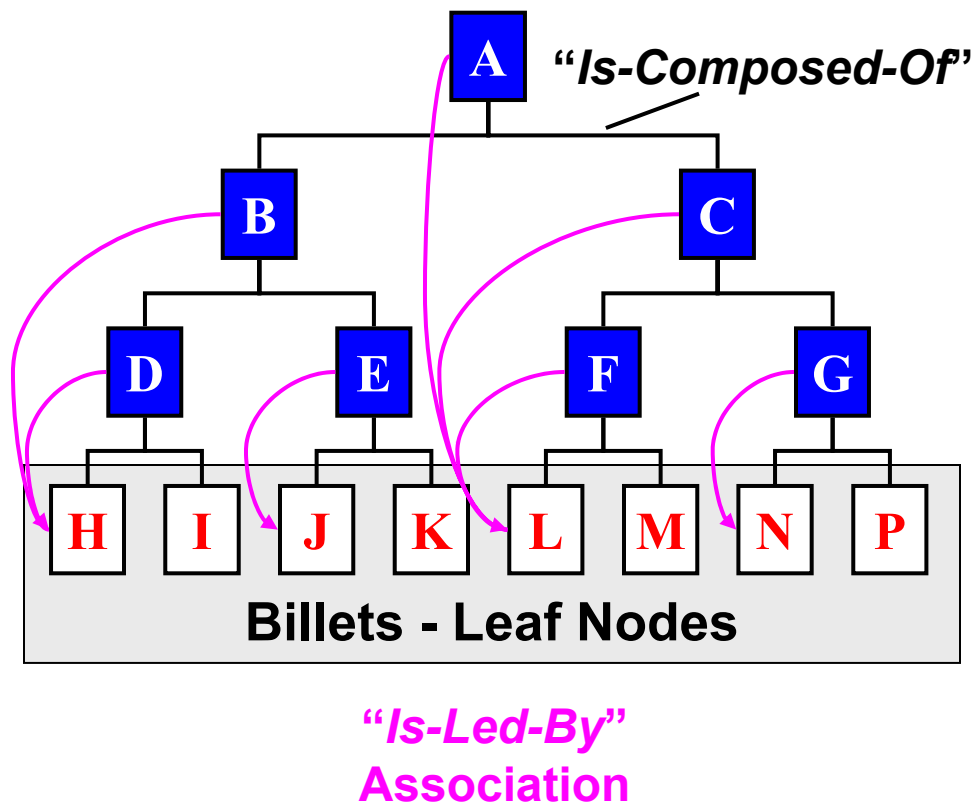
A **Command Structure** denotes aggregation and includes all organizations: Billets, Crews, and Doctrinal

Internal nodes can be active (in use) or dormant

But since someone is ALWAYS in charge of an active group, an active internal node must have a designated leader - a reference to a billet

This is called an "is-Led_by" Link

Command Structure Versus Chain of Command
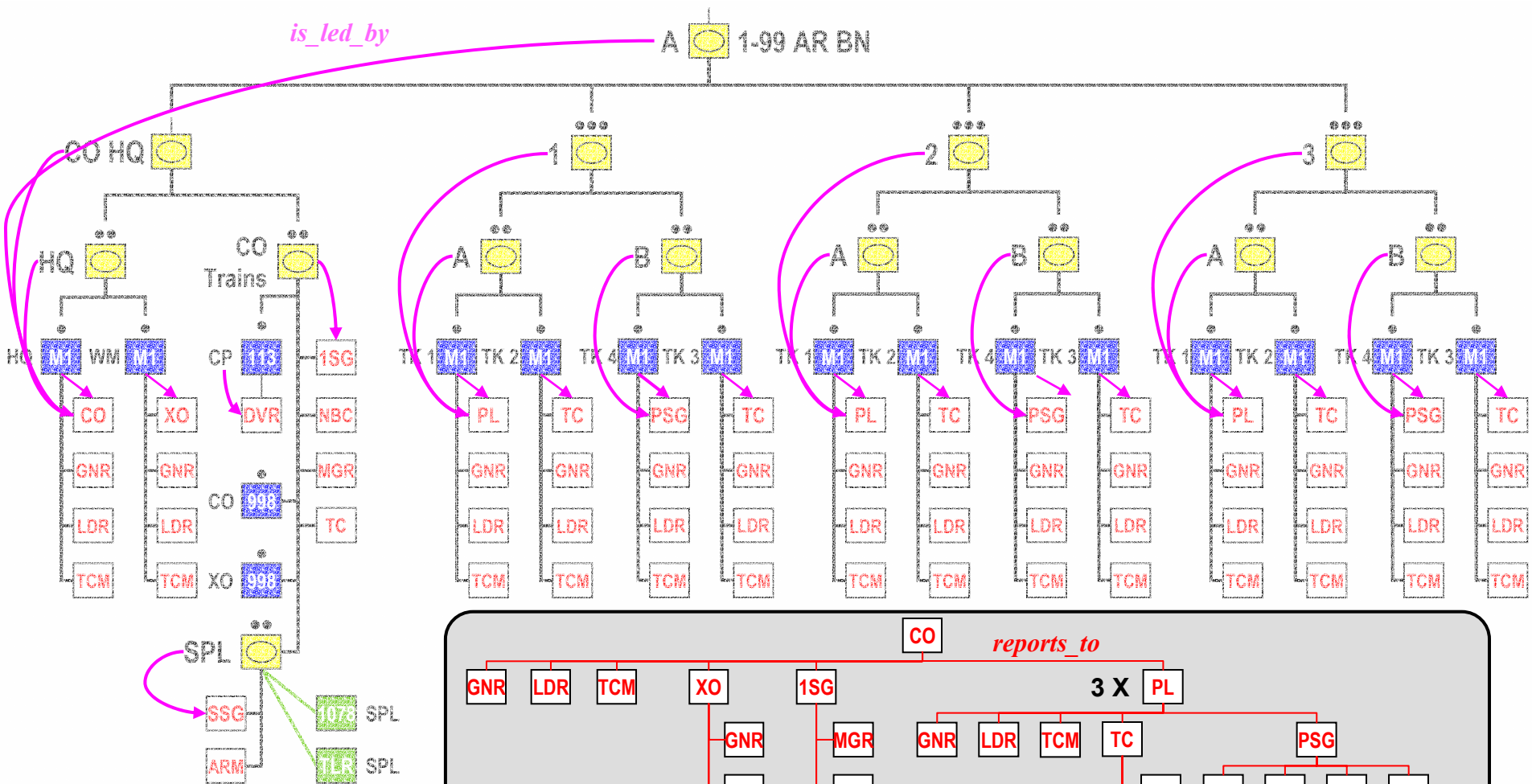
A **Chain of Command** only includes billets and the links are interpreted as "reports_to"

Example – Exploiting DOOs to Simplify and Unify the Representation of Strike Packages
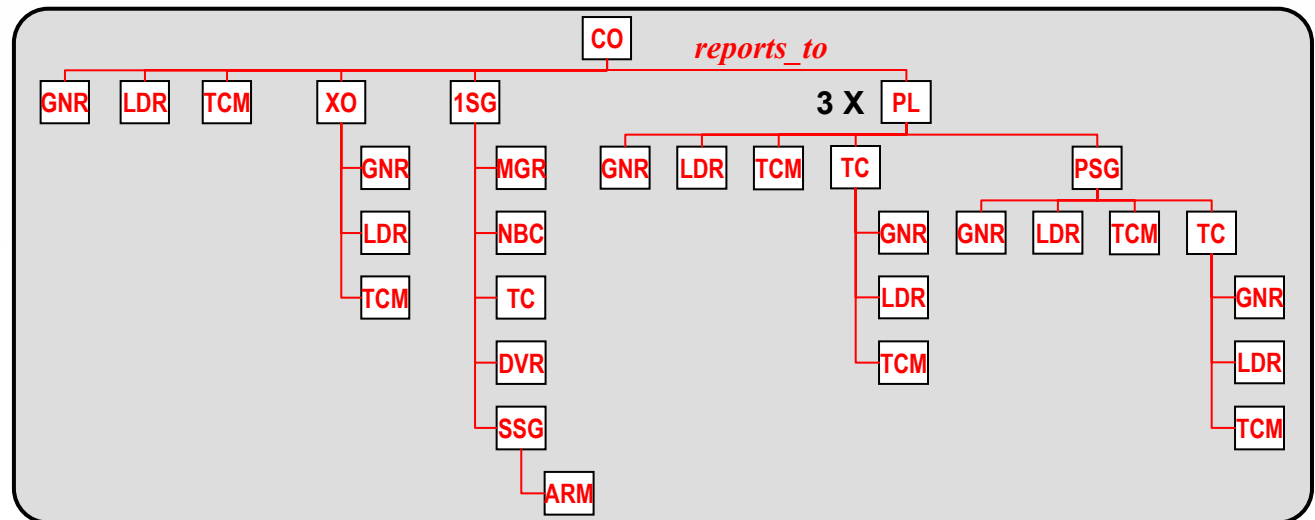
Assign Strike Package Leadership & Aliases

There is a **Person** Associated With Each Billet and an **Aircraft** Associated with Each Crew

"Hammer 41" Division of 4 FA-18D

GFM Org Server Data Domain Membership
(Based on C2 Information Exchange Data Model, C2IEDM)

**Mat_Type &
Pers_Type**

Org_Type Tree

Org Tree

**Real
Entities**

**F/A-99 Crew
(Variant 2)**

Crew 12

| Mat_Type | ← | 1 | ← | Org_Type
(Crew) | ⟵⟵ | Org
(Crew) | ⟵⟵ | Materiel |

**Model: F/A-99D
NSN: 1510-01-…
Weight: 25,000 lbs**

*F/A-99
Tail #653421*

2

Org
(Billet)

Pilot 12

Person

Capt Smith

| Pers_Type | ← | 1 | ← | Org_Type
(Position) |

**Capt
PMOS X
ASI Y**

Pilot

Org
(Billet)

Co-Pilot 12

Person

LT Jones

← **Entities in Traditional
Authorization Document** →

**Status
Data**

← **Org Server Entities** →

No Common Naming Convention

Concepts and Principles Behind Enterprise Identifiers, or EIDs

Recently renamed by the DoD to Enterprise-Wide Identifiers, or EwIDs, as part of a draft DoD Directive

Enterprise (wide) Identifiers (EwID)

- **Identifier**: a property that uniquely distinguishes an item.
  [*The most basic requirement of data*.]

- **EwID**: An identifier that is unique across the enterprise (e.g., DoD).

- Fundamental (Required) Characteristics:

  - It includes <u>no information</u> about the entity it identifies
    (called a "surrogate key" in relational databases).

  - It is a fixed size (ease of software development and interoperability).

- Recommended Characteristics:

  - Size: 64 bits is the smallest size that will do the job
    (bandwidth is a consideration)

  - Allocation Scheme: Global Prefix, Local Suffix for simplicity.

- When any data is created, it is tagged with an EwID that remains associated with it for its life – this includes the o*rganization, materiel, and personnel* domains.

- Technical Challenge: to guarantee uniqueness without sacrificing reliability and performance (i.e., no bottlenecks).
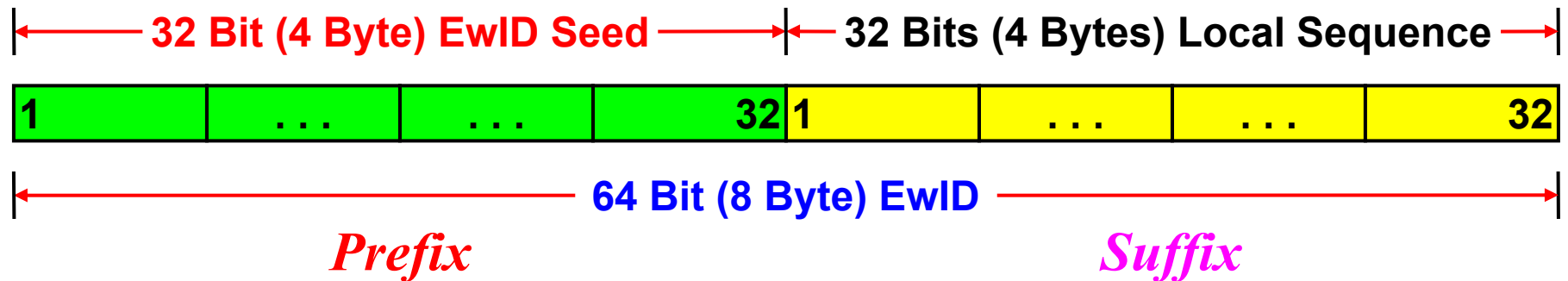
EwID Formulation Scheme

An enterprise-wide identifier to uniquely identify *any item* in *any database* can be composed by combining unique identifiers.

First, a globally unique, four byte (32 bit) "EwID Seed"
is obtained from an EwID Seed Server.

| ←——— 32 Bit (4 Byte) EwID Seed ———→	←— 32 Bits (4 Bytes) Local Sequence —→
1 32	1 32

←——————————————— 64 Bit (8 Byte) EwID ———————————————→

Prefix   *Suffix*

Then, an EwID Server is established to provide EwIDs to users by producing
globally unique, eight byte (64 bit) EwIDs by appending a locally controlled,
unique, four byte (32 bit) suffix to the EwID Seed prefix.

The common, eight byte (64-bit) *enterprise-wide identifier* format allows
2^{64} bit patterns = 18.45 X 10^{18}, or 18.45 Exa-identifiers,
or 18 Billion Billion Unique Entities to be tracked.   In other words . . .
4.3 billion EwIDs can be produced from each of the 4.3 billion EwID Seeds.

Enterprise-wide Identifier Allocation Hierarchy
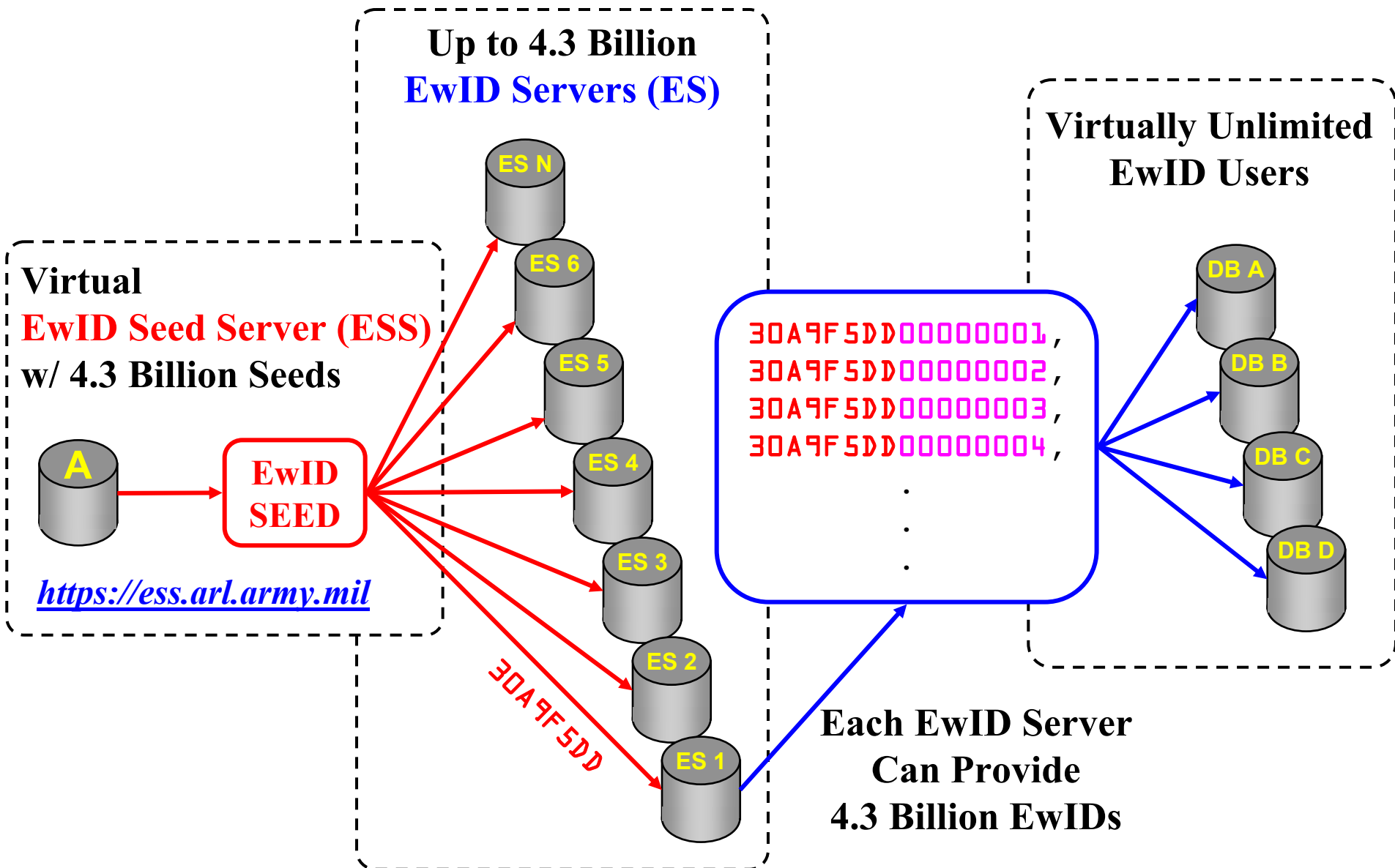
EwID Summary

- **Data identification will have to be accomplished somehow. This is but one of many possible techniques; the hard part is the task of selecting one.**

- **EwID is a <u>Data Type</u>, not an attribute (column) name**

- **Obtaining EwID Seeds is not intended to be a real-time process. This occurs when the systems are built and configured.**

- **EwID Seeds are free (see: *https://ess.arl.army.mil*)**

- **EwID characteristics & advantages:**
  - ↗ **No embedded information – they give away no information**
  - ↗ **Registration-based, this allows them to be compact & efficient (no waste)**
  - ↗ **Simple, fixed size – easy for software engineers to use**
  - ↗ **Easy to implement (add to legacy DBs as Alt Keys)**
  - ↗ **Data Miner's Dream – all data is tagged with a common structure**

Summary

Standardized force structure representation across the Services is fundamental to DOD transformation.

- **Force structure is a central theme of Battle Command**

- **Use Timed Tree Graphs**

- **Crews and Billets are Organizations Too.**

- **Data maintenance is the key to success – the force development community must maintain the data.**

- **A common data identification (key management) scheme (now called Enterprise-wide IDs, EwIDs).**

- **Functionally, must support:**
  - **The building of any arbitrary task organization**
  - **Software engineering and development to facilitate the creation and maintenance of algorithms and applications**

For More Information

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